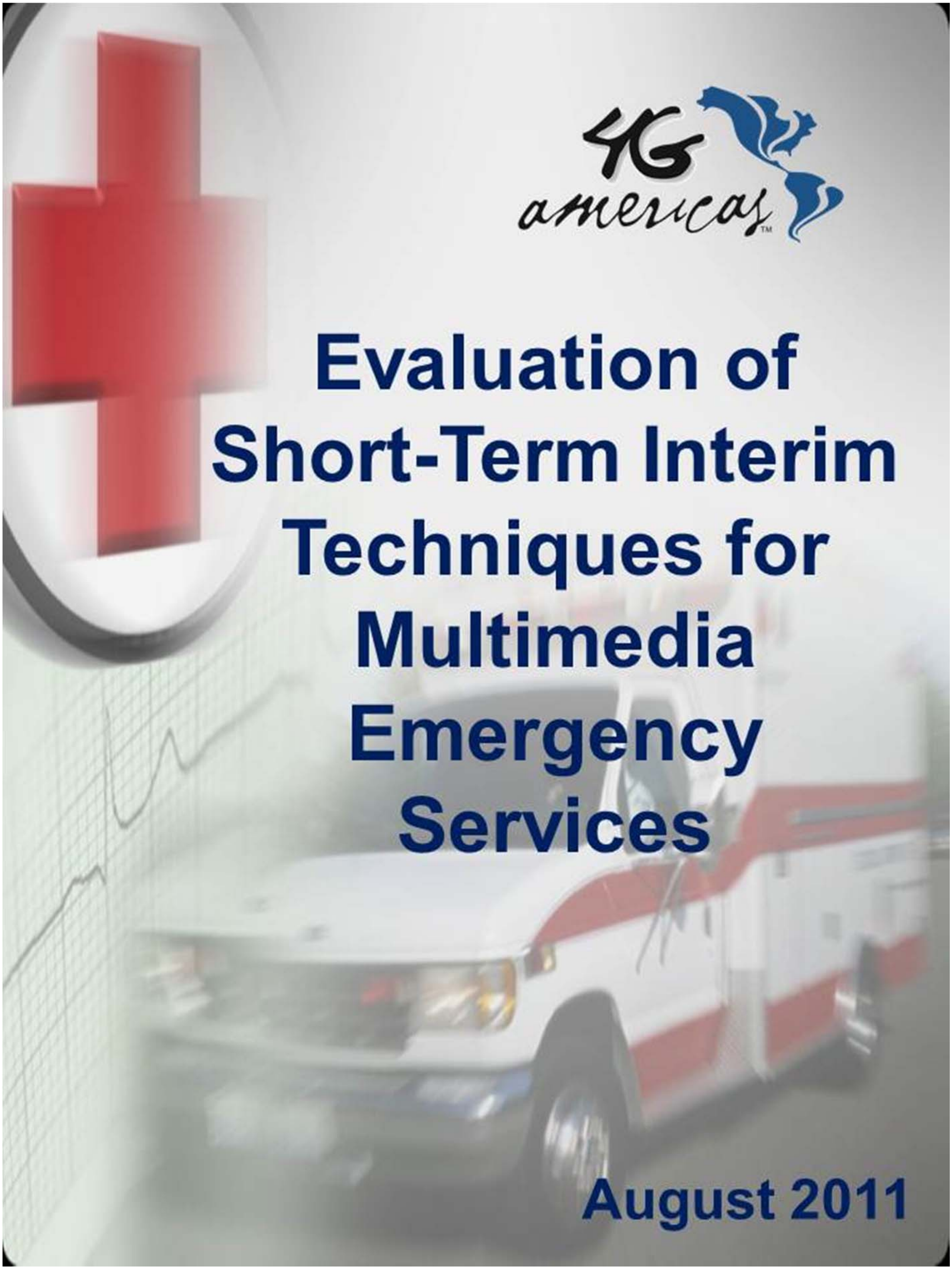

Evaluation of Short-Term Interim Techniques for Multimedia Emergency Services

August 2011

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EXECUTIVE SUMMARY

There is a desire by both the Emergency Services community and the community of individuals with disabilities to have text based wireless communications with emergency services. Both NENA (National Emergency Number Association) and 3GPP (3rd Generation Partnership Project) have developed use cases and requirements for a long-term IMS-based multimedia solution and provide a rich set of emergency communications capabilities in a Next Generation 9-1-1 (NG9-1-1) environment. This long term solution would provide accessibility to emergency services for the general public including individuals with disabilities. However, the development and implementation of the long term solution will take several years. An interim solution that will support at minimum text based communications for individuals with disabilities has been requested.

The purpose of this white paper is to investigate options for an interim solution that can be supported by the both the existing wireless networks and Public Safety Answering Points (PSAPs). Any interim solution chosen should have minimal impacts on the entire emergency services system. End user devices and origination networks should use existing technologies and should be available to support an interim solution as quickly as possible. Likewise, the emergency services networks should require little to no change. The focus of this white paper is based on the use of existing technologies such as GSM and UMTS circuit and packet services. The LTE and IMS technologies are not within the scope of this white paper even though there are some LTE and IMS deployments in existence. It is expected that the long term Multimedia Emergency Services (MMES) solution being specified in 3GPP will be supported in the LTE and IMS environments.

The following potential techniques for an interim solution are examined in this white paper:

- Instant Messaging (IM)
- Video American Sign Language (ASL)
- Real-time Text (RTT) End-to-End
- RTT with TTY
- SMS to 9-1-1
- Voice Emergency Call then SMS
- TTY Emulation
- National SMS Relay Center
- Video Relay Service
- IP Based Relay Service

Each of these potential techniques is described in section 2 of this white paper and these descriptions include the benefits and limitations of each technique. Section 3 of this white paper provides a color coded side-by-side comparison of each potential technique.

Based upon the analysis contained within this white paper, the following conclusions can be drawn regarding an interim short-term solution:

1. All of these potential techniques have issues and limitations which impacts the use of the technique as an interim short term solution. Subscribers will need to be educated that any interim solution will have limitations and restrictions.

2. Relay based services such as Video Relay Service and IP Based Relay Service are potential techniques for an interim solution. These techniques have minimal impact to existing mobile devices, to wireless network infrastructure, and to emergency services networks.

3. SMS based techniques such as National SMS Relay Center and the Voice Emergency Call then SMS are potential techniques for an interim solution, if an SMS based solution is required. These SMS based techniques have the same inherent issues of SMS as described in the 4G America's white paper on texting to 9-1-1[1] which was published in October 2010. These techniques have little or no impact to the wireless networks and limited impact to the emergency service networks. However, not all currently deployed mobile devices will support the Voice Emergency Call then SMS technique. The Voice Emergency Call then SMS technique is currently under trial in Canada.

4. SMS to 9-1-1 continues to have serious issues and limitations as described in the 4G America's white paper on texting to 9-1-1. Implementation of SMS to 9-1-1 would have significant impacts to wireless network infrastructure and to the emergency services networks and, therefore, is not considered to be a suitable interim solution.

5. Interim solutions based upon real-time text (RTT) are not feasible as interim solutions since the 3GPP standards for the support of RTT in wireless networks requires the IMS (IP Multimedia Subsystem) subsystem. The IMS subsystem is not widely deployed, is not likely to be deployed on 3G systems, will not be deployed on 2G systems, and is not supported by the mobile devices currently being used by the subscribers.

6. Instant Messaging (IM) is not considered to be a viable technique for an interim solution. Generally, the IM services available to subscribers today are the services offered by the major IM service providers such as AOL, Yahoo, Google, and Microsoft. None of these services currently support emergency messaging so additional development would be required by these third party IM service providers and by the PSAP systems. Additionally, since these systems are proprietary, the PSAP systems may have to interface to each of these IM services.

7. Video ASL is not considered to be a viable technique for an interim solution. The ability of the existing wireless network to support the required video resolution is marginal. The PSAP systems would need to be updated to support incoming video calls. Additionally, proficiency in American Sign Language is not a common skill for PSAP call takers.

8. TTY Emulation is not a viable technique for the interim solution. For TTY Emulation to work effectively modifications to the mobile device operating systems are required which implies new mobile device development and new mobile device acquisition by the subscribers. Initial prototype systems have demonstrated the potential of the concept but have not yet been able to meet the FCC requirements for error rate.

None of the short-term techniques for multimedia emergency services can be supported without a significant development effort. The implementation of any short-term interim techniques for multimedia emergency services will require resources and time to develop and deploy. Also, the issue of funding for the development and deployment of any short-term technique also needs to be addressed.

[1] 4G Americas, *Texting to 9-1-1: Examining the Design and Limitations of SMS*, October 2010.

1. INTRODUCTION

There is a desire by the Emergency Services community, as well as, the community of individuals with disabilities to have multimedia emergency services supported with the same general characteristics as emergency voice calls. As a result, there is a need to communicate with emergency services using mechanisms that are not primarily voice.

NENA and 3GPP have developed use cases and requirements for multimedia emergency services. Multimedia Emergency Services (MMES) standards will offer a long-term IMS-based multimedia solution and provide a rich set of emergency communications capabilities in a NG9-1-1 environment. MMES standards are intended to support text communications between end users and emergency services.

The MMES standards capabilities will facilitate emergency communications by the general public including individuals with disabilities (e.g., persons who are deaf, deaf-blind, hard of hearing, or have a speech disability). The MMES standards solution should be viewed as the long-term solution for providing accessibility to emergency services not only to people with disabilities.

As this is a major change to the 9-1-1 system, adoption of MMES standards capabilities will take several years. There will be significant impacts to the entire emergency services system resulting from the changes in networks and devices. It is expected that end user devices and origination networks will ultimately evolve, and that the next generation emergency services solution will allow this evolution to take place over time. Many systems in the emergency services network must eventually change. New end-to-end messaging relationships must be established.

There may be a need to provide a multimedia emergency communications solution prior to the availability of the long term MMES standards based upon IMS-based networks. A number of potential interim solutions are examined in this white paper.

Any interim solution chosen should have minimal impacts on the entire emergency services system. End user devices and origination networks should use existing technology and should be available to support an interim solution as quickly as possible. Likewise, emergency services networks should require little to no change. The focus of this white paper is on the use of existing potential technologies that includes GSM and UMTS circuit and packet services. The LTE technology is not within the scope of this white paper even though there are some LTE deployments in existence.

This paper is intended to identify and analyze the various interim potential solutions. It will also identify the best possible interim multimedia emergency communication solution, and identify any gaps for an end-to-end interim multimedia emergency communication solution, including impacts to subscribers and to PSAPs.

The acronyms and definitions used in this white paper are provided in Appendix A.

2. OVERVIEW OF POTENTIAL TECHNIQUES

This section discusses the following potential techniques for providing an interim solution:

- Instant Messaging (IM)
- Video American Sign Language (ASL)
- Real-time Text (RTT) End-to-End
- RTT with TTY
- SMS to 9-1-1
- Voice Emergency Call then SMS
- TTY Emulation
- National SMS Relay Center
- Video Relay Service
- IP Based Relay Service

The discussion of each potential technique includes a description, the potential benefits, and any associated limitations.

There is no implied preference of the potential techniques based upon the order within the above list and within this section.

2.1 INSTANT MESSAGING

DESCRIPTION

Instant Messaging (IM) is a packet based service that is one of the fastest growing forms of communication. IM allows users to instantly exchange messages back and forth often within a session but also as stand-alone messages, thereby permitting communication to happen in near real-time on a message by message basis. Depending upon the IM application, messages are primarily simple textual messages or less frequently the IM messages may be richer multi-media messages. IM works either from a user's personal computer or mobile device.

From an end-user's perspective, IM is simple to operate. The user chooses an IM application, downloads and installs an IM-client software on their device – usually a laptop, PC or mobile. The client is a GUI-based device with interfaces to type messages and see the responses. The user also creates a user-account with a login and password that is associated with the service and configures the IM-client application to login under that identity. Almost all IM-applications allow a subscriber to create and manage a contacts list (also known as "buddies" or "friends-list" on the server. Most services allow those on the list to see the user's status and to send messages without further permission. The user also has the ability to set attributes relating to their IM-persona – this may include their current connection status (available, idle, do not disturb, etc.), moods (happy, sad, bored etc.)

Most IM services support presence, where the user's friends and their corresponding statuses (online, invisible, idle, offline, mood, and status message) appear in the user's client-software GUI-window on the end device.

A user starts a "chat" session, often with another user who is on their friends-list and who is also online. Many services also support sending messages outside of a session (e.g., stand-alone messages) and/or sending messages or starting a chat session with a user who is not on the contacts list. The user double-clicks on another user's name in the friends-list to pull up a chat-window or types an IM identity into a message window. The user types in a message and presses send. This message appears on a GUI chat-window on the user's friend's end device through which the user's friend has logged into the IM application. Messages can be exchanged back and forth this way. A user may communicate with multiple users via group-chat.

Most services allow users control over who can send them messages, initiate chat sessions, and see their status, such as all users, only those on their contact list, or to request permission each time.

IM is not like SMS because there are multiple proprietary implementations of IM (such as Yahoo Messenger, AOL IM, MSN, Google Talk, XMPP/Jabber or SIP). Due to the multiple implementations of IM, it is possible for a user to subscribe to more than one IM service in order to be able to communicate with all of their friends. Many services have their own dedicated client software application, but independent multi-protocol clients are also popular, which support simultaneous usage among multiple services and multiple instances of decentralized services. In addition to client-based interworking, server-based interworking is supported by some service applications and thereby has multiple IM-clients on their end device – for instance, a user may subscribe simultaneously and use Yahoo Messenger, Google Talk, and MSN etc.

Instant Messaging applications consist of two components: a) client software and b) server software. Although some IM applications work through a web-browser interface, most IM applications require client software to be installed on the client device and either pre-configured with the address and port of the IM server to which to connect to, or to use a discovery mechanism such as DNS. Additionally, the client may also be configured with the user's account information (Login and Password) using which the server authenticates the end-user. The server maintains the user's contact list information and allows the user to manage it. It acts as a cross-connect for communication traffic between consenting users who are online. Some servers may have the capability to store off-line messages and deliver them later when a user comes back online[2].

A description of the architecture and protocols for Instant Messaging is provided in Appendix B.

The utilization of IM for emergency communications with the PSAP would require the end user to establish a chat session with the PSAP. To establish an emergency IM session with a PSAP, the IM service would be required to do the following:

- Recognize emergency services request (e.g., "SOS", "911") as a special IM identity for emergency services;
- Determine the subscriber's location (e.g., prompt the subscriber);
- Determine the appropriate PSAP for the subscriber's location;
- Maintain a chat association between the subscriber and the PSAP.

BENEFITS

IM lends itself to multimedia communication and particularly to the needs of the disabled community. It is near real-time, widely-used and freely available. Many IM applications such as Yahoo! Messenger and Google Talk can be freely downloaded from the Internet and work with most operating system. Many popular devices, including desktop, laptop, notebook, mobile, and pad devices, come bundled with IM applications supported by the operating system or device vendor. IM can carry text or other multimedia content within the same architectural

[2] How Instant Messaging Works, Information Management Journal Nov/Dec 2003 at http://findarticles.com/p/articles/mi_qa3937/is_200311/ai_n9328272/ (Accessible as of Jan 31st, 2011).

framework. Additionally, it provides mechanisms for location to be specified as a Presence attribute – although this is not yet prevalently deployed.

Multi-protocol clients offer extremely broad interworking among virtually all IM services. Server-based interworking is also available.

LIMITATIONS

This service requires packet data service and an IM application that is compatible with the chosen PSAP IM application(s).

Enhancements are required in the IM client application and in the IM service provider platforms to support IM based emergency services with PSAPs.

There is a plethora of IM applications available that vary widely in their features, capabilities, and implementation. This presents challenges to the PSAP who may have to support all available IM types in order for all subscribers to be able to reach them.

Interoperability between IM applications remains an issue. Most client-server protocol implementations are proprietary. While there have been some collaboration between the major IM providers, no universal standard has taken hold.

Some IM applications have a store and forward capability. Like SMS, the store and forward capability could be detrimental during an emergency.

IM applications do not have the capabilities of the current circuit-switch centric 9-1-1 call routing and location infrastructure to be able to support the location determination and IM session routing to the appropriate PSAP.

Additional information about the limitations of IM for emergency services is contained in Appendix B.

2.2 VIDEO ASL

DESCRIPTION

With the advent of smartphones with photo/video capability, people who communicate with American Sign Language (ASL) could utilize such devices to interact. Research is being conducted in the US[3] to improve the video compression ratio in situations where wireless bandwidth is limited. Such techniques must maintain compatibility with existing video compression standards like H.264/AVC. Any video telephony application that provides the capability for individuals to communicate using ASL, can be considered as Video ASL.

Based on some published results, the following characteristics are of interest:

- 95% of eye movements within 2 degrees visual angle of the signer's face
    - Implications: Face region of video is most visually important
        - Detailed grammar in face requires foveal vision
        - Hands and arms can be viewed in peripheral vision

[3] For additional details, please refer to http://mobileasl.cs.washington.edu/

- Increased bit rate improved user experience. Please refer to Figure 1: User Preferences Results for Various Bit Rates and Frame Rates.
- Higher frame rate, however, did not result in improved user experience.

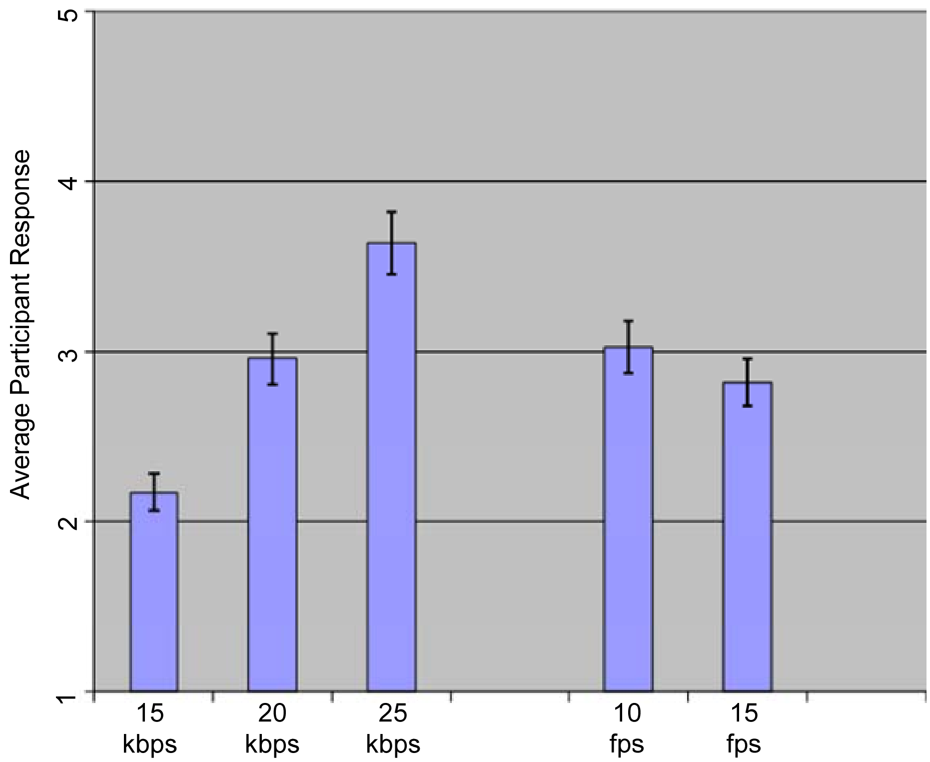

Figure 1: User Preferences Results for Various Bit Rates and Frame Rates

The utilization of Video ASL for emergency communications with the PSAP would require the end user to establish a video session with the PSAP. To establish an emergency video ASL session with a PSAP, the Video ASL service would be required to do the following:

- Recognize emergency services request;
- Determine the subscriber's location (e.g., prompt the subscriber);
- Determine the appropriate PSAP for the subscriber's location.

BENEFITS

This service enables hearing and speech impaired users to use and existing technology to interact. It requires minimal changes to standards and can be readily deployed and used.

LIMITATIONS

Enhancements are required in the Video ASL client application and in the Video ASL service provider platforms to support Video ASL based emergency services with PSAPs.

There is a plethora of video applications available that vary widely in their features, capabilities, and implementation. This presents challenges to the PSAP who may have to support all available video types in order for all subscribers to be able to reach them.

This service requires a phone capable of video telephony (e.g., front facing camera, appropriate video applications, handset positioning stand) that is compatible with the PSAS video telephone application(s). Although, many of the recent smartphones have this capability, it is not universally available in all devices.

Video ASL requires a data packet service with a minimum bit rate to work properly; as such, it is not suitable for legacy (2G) access technologies.

PSAPs are not currently equipped to handle this service.

2.3 RTT END-TO-END

DESCRIPTION

In some markets, there are regulatory requirements that people with a hearing or speech disability must be able to perform text based communication. For the 3GPP packet data based IP Multimedia Subsystem (IMS), Global Text Telephony via the Real-Time Text protocol over RTP (i.e., GTT-IP) has been specified by 3GPP in TS 22.226[4] and in TS 23.226[5] to address these regulatory requirements using packet data. GTT-IP is supported using IETF SIP/SDP for the negotiation of the text media and IETF RFC 4103[6] RTP-text for transport, with text coded according to ITU T Recommendation T.140[7]. This allows conversation in a selection of simultaneous media, such as voice, text and potentially also video.

The calling party identity and location information are supported as in IMS packet data voice emergency calls.

Depending on local regulation and operator's policy, it may also be required to support emergency calls originated by terminals without a valid subscription. In these cases RTT is supported as in the case of IMS emergency calls for UE with a valid subscription.

The figure below illustrates an IMS terminal that originates an IMS call containing both packet voice and RTT media, where each media is conveyed in an independent media stream. The far end can be an IMS network, a PS packet data network supporting RTT using SIP/SDP or a packet data PS terminal supporting RTT via SIP/SDP.

[4] 3GPP TS 22.226: “Global Text Telephony (GTT), Stage 1”
[5] 3GPP TS 23.226: “Global Text Telephony (GTT), Stage 2”.
[6] IETF RFC 4103: "RTP-Text. RTP Payload for Text Conversation".
[7] ITU T Recommendation T.140: "Text conversation presentation protocol".

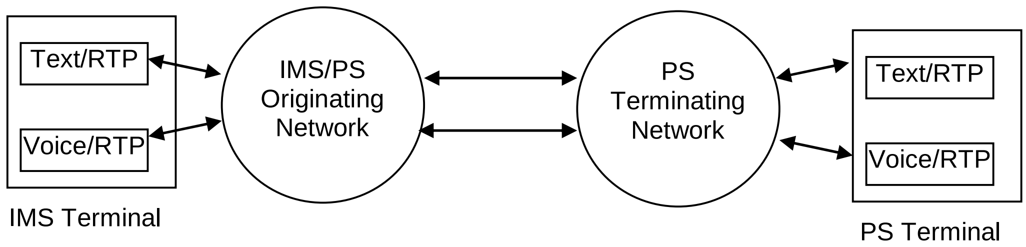

Figure 2: IMS Terminal with voice and RTT media

Inclusion of the text conversation is done according to normal SIP and IMS procedures, where the text media stream is handled as any other media. It is possible that an IMS call can be set up using only text media.

It is assumed that IMS terminals supporting text media will not automatically offer text media, but that this will be instead governed by terminal configuration options and user interactions to suit the communication preferences and abilities of the user. However, an IMS terminal desiring to set up a RTT call will offer Real-Time Text media, possibly in parallel to voice media. For a call terminating to an IMS terminal configured to use Real-Time Text Telephony but receiving an SDP offer for voice-only media will accept this offer and then send a subsequent SDP offer adding text media in a distinct SDP media line (e.g., using a SIP UPDATE).

GTT-IP has no architecture influence on the 3G Packet Services (PS) network, only that the components must allow handling of the standardized text media stream. If GTT-IP will be used to support IMS emergency calls where terminals without a valid subscription must be supported then only PS for UTRAN and E-UTRAN have been specified to allow access to meet these regulatory requirements.

BENEFITS

RTT allows character by character transmission, similar to TTY.

RTT may be more reliable than TTY over wireless since the protocol supports sending RTT with redundancy sent compared to TTY being sent as tones on the voice channel where some voice frames can be dropped and not recovered.

Optionally, RTT can be used simultaneously with other media types (e.g., voice, video), unlike TTY that is transmitted on the voice channel.

LIMITATIONS

RTT support is needed both in IMS and at the far end (e.g., other IMS network, IP network or IP terminal).

RTT requires packet data service and IMS.

2.4 RTT WITH TTY

DESCRIPTION

For the packet data based IP Multimedia Subsystem (IMS), IMS interworking between Real-Time Text (RTT) and PSTN text telephony is specified by 3GPP in TS 22.226[8], TS 23.226[9] and TS 29.163[10] by introducing conversion in the IMS-PLMN between IP-based Real-Time Text via RTP and modem based transmission of real-time text using ITU T Recommendation V.18[11] or any of its specific sub-modes as specified in TS 26.114[12].

The calling party identity and location information are supported as in IMS packet data voice emergency calls.

Depending on local regulation and operator's policy, it may also be required to support emergency calls originated by terminals without a valid subscription. In these cases RTT / V.18 interworking is supported as in the case of IMS emergency calls for UE with a valid subscription.

Call back from emergency services is interworked as an IMS Mobile Terminating call.

The interworking (conversion) function can be seen as a context containing a packet data Text/RTP termination plus a packet data voice/RTP termination on the IMS side and an ITU-T Recommendation V.18[11] text telephony termination with multiplexed V.18 and voice via PCM on the PSTN side as illustrated below.

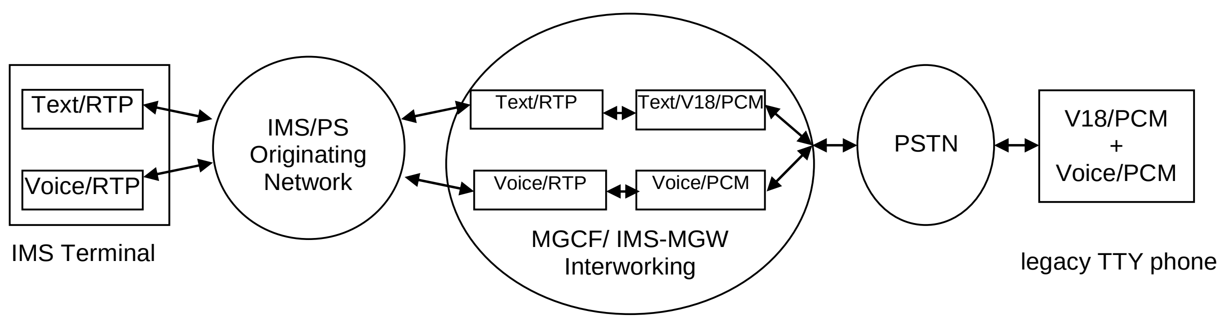

Figure 3: RTT Interworking with PSTN

In the PSTN, different specified systems for text telephony exist and are used in different regions, e.g. Baudot (in US), EDT, V.21, Bell103, Minitel and V.18. They all use different modem technologies within PCM and different character coding for the transmission of text. They are described in the annexes of ITU-T Recommendation V.18 [125]. ITU-T Recommendation V.18[11] is an international text telephone modem standard with an automoding mechanism that enables communication with all the different kinds of PSTN text telephone systems. Optionally, any party of a RTT call may at any time initiate text or send voice. Speech and text may be used in an alternating manner during a conversation on the PSTN. It is also possible that speech is transferred in one direction and text in the opposite direction. However, speech and text cannot be used in the same direction at the same time in most sub-modes of V.18.

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[8] 3GPP TS 23.226: “Global Text Telephony (GTT), Stage 1”.
[9] 3GPP TS 23.226: “Global Text Telephony (GTT), Stage 2”.
[10] 3GPP TS 29.163: "Interworking between the IM CN subsystem and CS networks - Stage 3".
[11] ITU T Recommendation V.18 (11/00) : "Operational and interworking requirements for DCEs operating in the text telephone mode" including V.18 (2000) Amendment 1 (11/02): "Harmonization with ANSI TIA/EIA-825 (2000) text phones".
[12] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

In the 3GPP CS radio interface, a dedicated CTM modem is used which is terminated within the CS domain and interworked to PTSN in-band TTY format.

Similarly, interworking between RTT over RTP within IMS and PSTN TTY is provided at the MGCF / IM-MGW by the MGCF triggering the insertion of an Interworking (conversion) function within the IMS-MGW which then behaves in accordance with ITU-T Recommendation V.18[11] or any of its specific sub-modes.

The support of this Interworking function between IP-based Real-Time Text over RTP and modem based transmission of real-time text is optional both at the MGCF and IM-MGW, but can be required by national regulatory bodies.

The Interworking function in the IM-MGW shall support the detection of text modem signals on the CS side and the conversion between text/modem signals and Real-Time Text over RTP.

The IM-MGW supports at least one of the sub-modes listed in ITU-T Recommendation V.18[11] (e.g. Baudot).

The procedures to detect and convert text/modem involve expensive MGW resources. The present RTT interworking procedures intend to allow cost effective implementations by avoiding additional load or resources in MGW for calls not using text telephony (which represent most of the calls).

It is assumed that IMS terminals supporting RTT will not automatically offer RTT media, but that this will be instead governed by terminal configuration options and user interactions to suit the communication preferences and abilities of the user. However, an IMS terminal desiring to set up a RTT call will offer RTT media, possibly in parallel to voice media. The IMS-MGW shall then provide the conversion between RTT over RTP and TTY modem signals. On the contrary, if the mobile does not request RTT support, no Interworking function is necessary. An IMS terminal configured to use RTT but receiving an SDP offer for voice-only media will accept this offer and then send an own subsequent SDP offer adding RTT media. When receiving such a subsequent offer for RTT media, the IMS-MGW shall provide the conversion between RTT over RTP and TTY modem signals at the CS interface.

RTT/TTY interworking has no architecture influence on the 3G Packet Services (PS) network, only that the components must allow handling of the standardized text media stream and support RTT/TTY interworking. If RTT/TTY interworking will be used to support IMS emergency calls where terminals without a valid subscription must be supported then only PS for UTRAN and E-UTRAN have been specified to allow access to meet these regulatory requirements.

BENEFITS

See the RTT benefits in section 2.3.

Additionally, RTT/TTY interworking allows RTT to be used for IMS emergency calls to a PSTN based PSAP.

LIMITATIONS

This technique requires packet data services and IMS.

This technique requires RTT/TTY interworking function.

2.5 SMS TO 9-1-1

DESCRIPTION

Short Message Service (SMS) is a text based communications service which allows subscribers to send text messages to each other via their mobile phones. Millions of SMS text messages are sent and received daily. There is a desire within the user community, especially by individuals with disabilities, to be able to also send and receive SMS text messages from the emergency services PSAP.

In 2010, 4G Americas conducted an extensive evaluation of the issues and limitations regarding the use of SMS for texting to 9-1-1. The full description of texting to 9-1-1 and the results of the evaluation where published in October 2010 in the 4G Americas white paper on texting to 9-1-1[13].

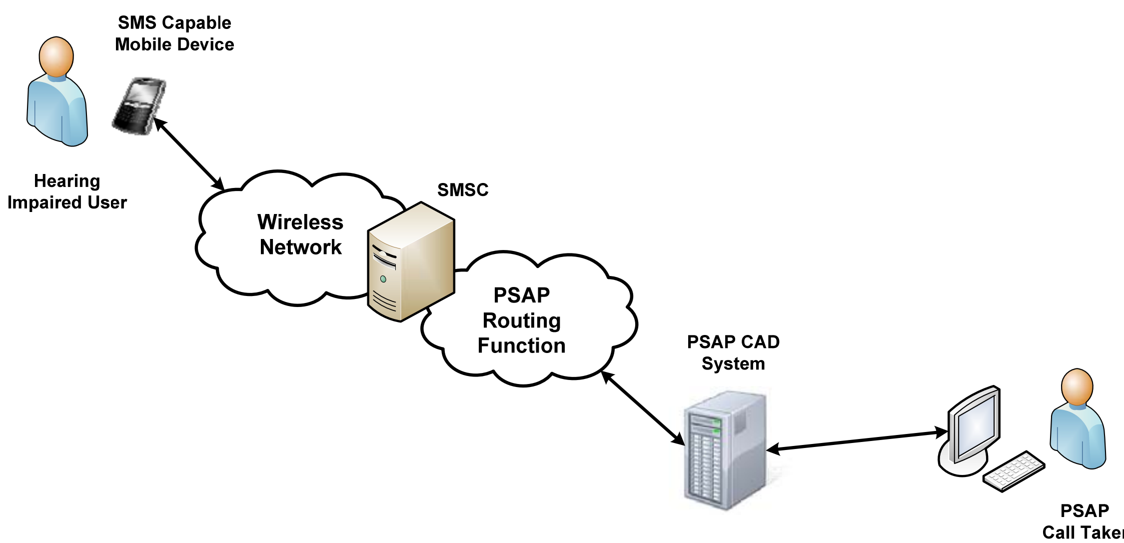

Figure 4: SMS to 9-1-1

BENEFITS

SMS is commonly used by many wireless subscribers.

LIMITATIONS

This service requires SMS to be active for the subscriber.

[13] 4G Americas, *Texting to 9-1-1: Examining the Design and Limitations of SMS*, October 2010.

The full list of limitations associated with SMS to 9-1-1 is available in the 4G Americas white paper mentioned in the description above. The following are some of the limitations that are mentioned in that 4G Americas white paper:

- SMS is a forward and store service with no service or performance guarantees;
- No location information is provided by the originating network or mobile device;
- Originating network unable to route to PSAP since no location information provided;
- No priority or special handling is given to SMS messages;
- No acknowledgments of sent, delivered or read SMS messages are provided by the originating network;
- No security, authentication, or non-repudiation of any SMS message is provided;
- SMS is not a session based protocol. There is no association maintaining by the originating network between the subscriber and the responding PSAP call-taker and, therefore, subsequent messages from the subscriber may be delivered to different PSAP call-takers.

2.6 VOICE EMERGENCY CALL THEN SMS

DESCRIPTION

Currently Canadian telecom regulation CRTC is testing a short-term solution for the SMS communication with a PSAP, which may be a potential interim solution for various wireless technologies and deployments in the US.

The Canadian telecom regulation noted in the Telecom Decision CRTC 2010-224[14] (Canadian Radio-television and Telecommunication Commission) that various forms of text messaging are not viable 9-1-1 solutions for the benefit of persons with hearing or speech disabilities, i.e. the Deaf, Hard of Hearing, or Speech Impaired (DHHSI) community. SMS, IM RTT, and IP Relay do not support automatic routing to the appropriate PSAP or the automatic provision of caller location information to the PSAP. IM and RTT do not provide automatic subscriber identification information, such as a telephone number, which is provided automatically with SMS. In addition, the CISC ESWG (Canadian Radio-television Telecommunications Commission, Interconnection Steering Committee, Emergency Service Working Group) indicated in the report "Text Messaging to 9-1-1 (T9-1-1) Service"[15] that it would monitor the long term solution via NG9-1-1 standards and technologies to enable users to access PSAP via multimedia. The implementation of these capabilities will depend on the maturation level of IP networking and NG 9-1-1 networks and platforms.

Therefore in the short term, the CISC ESWG proposes the investigation of a potential work around for the benefit of persons from DHHSI community: testing a hybrid technology that a DHHSI person would dial 911 on a voice cellular phone, and their pre-registered personal information would appear to a PSAP indicating their disability. Basically, a wireless subscriber needs to pre-register for the DHHSI service possibly via a web site on the internet or through the WSPs' customer service infrastructure. This pre-registered user can then place a "silent" 9-1-1 voice call to indicate his needs for text messaging in addition to the registered information. The voice call is routed to the

[14] Canadian Radio-television and Telecommunication Commission (CRTC) Telecom Decision 2010-224, *CRTC Interconnection Steering Committee – Improving access to emergency services for people with hearing and speech disabilities*, 21 April 2010, http://www.crtc.gc.ca/eng/archive/2010/2010-224.htm

[15] Canadian Radio – television and Telecommunications Commission (CRTC) Interconnection Steering Committee (CISC), Report to the CRTC by the Emergency Services Working Group (ESWG), *Text Messaging to 9-1-1 (T9-1-1) Service*, Report Number: ESRE0051, January 21, 2010, http://pdf.911dispatch.com.s3.amazonaws.com/canada_txtmsg_rpt_2010.pdf

designated PSAP destination and location information is provided by the network establishing the voice call. The PSAP operator, receiving a "silent" wireless 9-1-1 call, will also receive a visual indication that the caller has registered with the SMS-to-9-1-1 service and requires 9-1-1 service via SMS messaging. The caller's location would use the existing cellular network methods in the same manner as a normal emergency voice call. The PSAP call taker would respond back to the caller using SMS messages based on the displayed callback information. Thus after receiving a PSAP SMS message at the emergency caller, the 9-1-1 caller is enabled to text back and forth with the PSAP call taker.

This so-called SMS T9-1-1 method does not enable the 9-1-1 caller to initiate the SMS text emergency call directly to a PSAP; it requires PSAPs to reply back with SMS. The CRTC acknowledged that this method would require PSAP to change their call handling procedures. The field trial could last 12 to 18 months. The trial will determine its effectiveness, develop and further validate a detailed technical service description and network architecture. At the time of writing this paper, no field trial result is available for the public access. The CRTC proposed activity plan of the field trial includes:

- Determination of the most efficient method for “flagging” a silent T9-1-1 to a PSAP;
- Determination of a SMS T9-1-1 registration process and architecture;
- Development of a detailed technical specification for the service;
- Development of a verification test plan;
- Validation of the technical specification in a controlled telecommunications environment;
- PSAP determination of the technical means, costs, funding, budgeting, and timing of implementing the T9-1-1 service;
- Cost estimation to launch the service nationally, and proposing methods to fund same;
- Determination of a reasonable rollout plan for all parties involved;
- Identification of specific PSAP staff training requirements;
- Identification of specific DHHSI community education requirements, e.g. how to register, how to place a T9-1-1 call, how to switch from voice to SMS;
- Preparation of a technical trial concluding report to the Commission.

The following figure depicts the Voice Emergency Call then SMS technique:

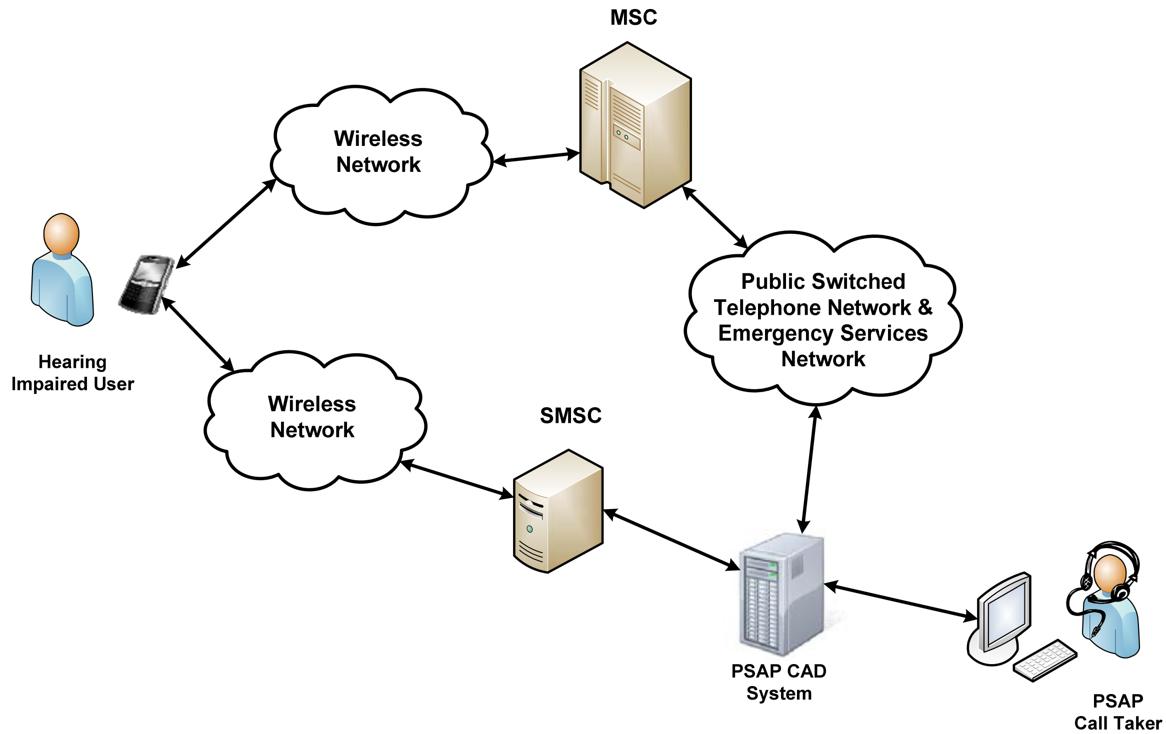

Figure 5: Voice Emergency Call then SMS

BENEFITS

It is further noted in the Telecom Decision CRTC 2010-224 that this "silent" wireless voice call solution for a pre-registered person has the advantages:

- Supports automatic routing of 9-1-1 calls to the appropriate PSAP;
- Enables the automatic provision of the 9-1-1 caller's contact and location information to the PSAP;
- Reduces implementation time with usage of existing network infrastructure.

LIMITATIONS

This service requires SMS to be active for the subscriber.

The interim solution is designed for disabled community and the field trial target to the DHHSI users; it is not for general public users. The pre-condition of this method is that SMS is supported by the end-devices, the user subscribes the SMS service from a service provider, and registers themselves as a DHHSI person with their voice service provider.

The SMS subscriber is restricted to use only the mobile device with the SIM/UICC card which has been pre-registered with the PSAP.

The solution supports text emergency excluding some kinds of wireless network user:

- non-subscribers of a wireless carrier or without an UICC;
- roamed-in users at a network without a roaming SMS agreement with his home network;
- subscribers without a pre-registration with emergency community to use this 9-1-1 text back service may not receive an SMS from PSAP with the silent voice call, and
- a pre-paid mobile device without a sufficient fund may not be able to receive from and text back to a PSAP.

There are other technical limitations from SMS, e.g., delay, and practical mobile device user interface to receive and send a message. These limitations are described in the 4G Americas' paper "Texting to 9-1-1: Examining the Design and Limitations of SMS"[16]. The "store and forward" nature of SMS is still inherent into this method with the possibility of delays.

In addition, this capability also requires the user to be able to SMS while on a voice call. Some mobile devices, including popular smartphones, this could be complex. For example, the receipt of an SMS message while on a voice call may only display a small icon with no other indication to the user of the received SMS message. To originate an SMS message, the user may be required to go through menus to get to the SMS text field, all without dropping the voice call. These complications may not make such a "silence voice call" solution user friendly and practical to an emergency situation.

2.7 TTY EMULATION

DESCRIPTION

TTY (Teletypewriter), also known as Telecommunication Device for Deaf (TDD), is a device that allows users with speech and/or hearing impaired to communicate over telephone lines using text-based messages.

The TTY devices have a keyboard allowing the users with hearing and/or speech impaired to type the text-based messages and a display screen allowing the users with hearing and/or speech impaired to see the incoming text-based messages. The characters of the text-based messages from/to the TTY devices are transported over the telephone connection in the form of Baudot 45.5 baud codes, using Frequency Shift Keying (FSK) tones with 1400Hz and 1800Hz frequency tones.

GSM/UMTS-based mobile devices provide the capabilities to transport these Baudot Tones over the air using Cellular Tone Modulation (CTM) techniques. The users with speech and/or hearing impaired would connect the TTY devices to GSM/UMTS-based mobile devices and then use the TTY device keyboard and display screen to perform the text-based communication over the GSM/UMTS networks.

The Title II of American Disability Act (ADA) of 1990 requires PSAP centers to have the equipment necessary to perform the text-based communication with the people with speech and/or hearing impaired. The Title IV of ADA 1990 requires the telecommunication service providers to complete calls originated from TTY devices or TTY device connected mobile devices to PSAP centers. In the GSM/UMTS-based networks, since the TTY devices are connected to mobile devices and the signals are carried over the established voice call, the location-based routing,

[16] 4G Americas, *Texting to 9-1-1: Examining the Design and Limitations of SMS*, October 2010.

location accuracy, call back requirements of E9-1-1 Phase I and Phase II requirements can be met in the same manner as voice calls.

The following figure depicts an overview of TTY usage:

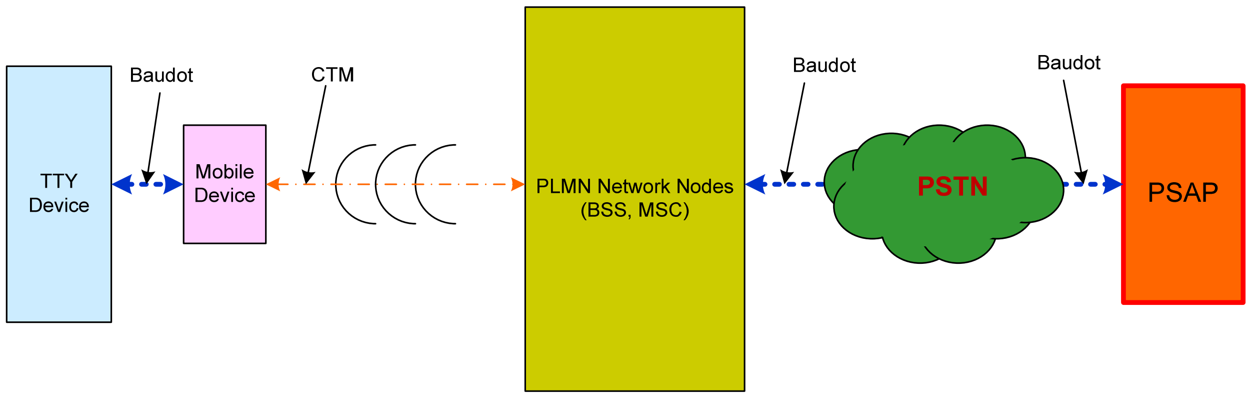

Figure 6: TTY text-based telephone connection using a TTY Device

TTY Emulation is a method where the application software built on a computing device with a modem could emulate the TTY devices connected to the telephone lines.

The TTY Emulation application software would provide the necessary function so that the text-based messages can be transported over the telephone connection in the form of Baudot 45.5 baud codes and would allow the users to use the key-board and the display screen of the computing device to type and read the text-based messages. The modem would ensure that the characters of the text-based messages are transported over the telephone connection using the FSK tones in the form of Baudot 45.5 baud tones.

The project at the Rehabilitation Engineering Research Center (RERC) has developed a TTY Emulation prototype called TTY Phone which, with the help of the application software, basically emulates a TTY device connected to a mobile phone. The TTYPhone application software when loaded on mobile smart phones would enable the mobile smart phones to emulate the mobile TTY phones which in other words would allow users with hearing and/or speech impaired to make TTY-text based phone calls using smart phones without the need to carry around the bulky TTY devices. The mobile TTY phones with the inherent capability of CTM tone generation/reception would emulate a true scenario of TTY device connected to GSM/UMTS smart phones. Users with speech and/or hearing impaired will be able to make TTY text-based emergency calls to PSAP centers using the mobile TTY phones. By allowing the users of mobile TTY phones to make 9-1-1 calls without the need to carry the bulky TTY devices, the mobile service providers can fulfill the spirit of the requirements of Title IV of ADA 1990 in a more practical way.

The following figure depicts an overview of TTY Emulation usage:

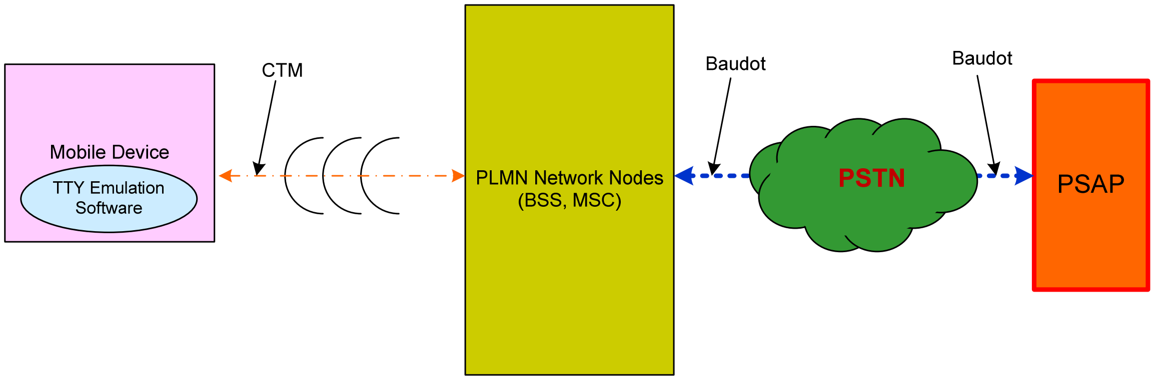

Figure 7: TTY text-based telephone connection using the TTY Emulation Software on Smart Mobile Devices

The further details about the RERC can be found at:

> http://www.wirelessrerc.org/publications/wireless-emergency-communications-2009-conference-proceedings/sessions/applications-the-alert-beyond-technical-track/deaf-911

TTY phone performance must comply with 3GPP TS 26.231[17] which defines the minimum performance requirements for CTM.

BENEFITS

A TTY device is bulky with its keyboard and display screen and hence, not easy to carry around whereas a smart phone with the built in TTY emulation software is basically a smart phone from hardware perspective. TTY Emulation requires no changes to the protocol and standards used to make text-based calls to the PSAP. The PSAPs that support the Title II requirements of ADA 1990 require no changes to interwork with TTY Emulation. In summary, TTY Emulation can be used with the existing wireless infrastructure and with the existing PSAP.

TTY Emulation supports bi-directional or uni-directional text transmissions thus allowing users with speech and hearing impaired or users with just speech impaired or the users with just the hearing impaired to make calls to the PSAP.

TTY Emulation can be used to emulate Voice Carry Over (VCO) and Hearing Carry Over (HCO) requirements as well.

LIMITATIONS

No commercially available mobile devices support TTY Emulation software capabilities.

Support of the TTY Emulation software on the mobile devices requires development on the mobile devices. The application APIs need to develop to allow the TTY Emulation software to provide CTM over the voice channel and must be tested to comply with the 3GPP TS 26.231[18].

[17] 3GPP TS 26.231: “Cellular Text Telephone Modem; Minimum Performance Requirements”.

2.8 NATIONAL SMS RELAY CENTER

DESCRIPTION

SMS is popular among the deaf and hard of hearing due to the ease of communicating and the possibility of being alerted to incoming messages immediately, as for an incoming phone call, by tactile means (e.g. phone vibration).

Emergency SMS messages are sent to a centralized national SMS relay center that serves as a means of providing a voice connection to an appropriate PSAP. The service would normally be used by hearing or speech impaired users as a substitute for an inability to talk directly with a PSAP operator. The figure below provides an illustration of the service in the case that a separate PSAP is contacted either via a human operator or an automated text-voice conversion facility at the relay center.

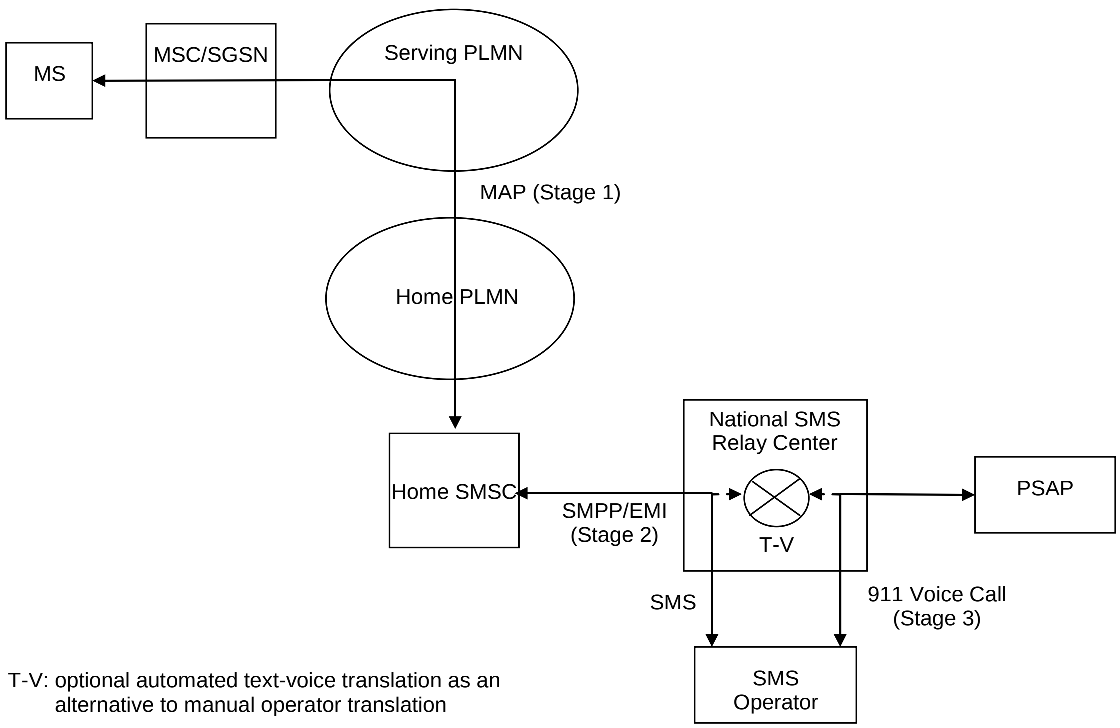

Figure 8: SMS Communication with a PSAP via a National SMS Relay Center

Each SMS message can contain up to 140 octets of data encoding up to 160 7-bit characters. Concatenated SMS, when supported, allows multiple separate SMS messages to be combined to increase effective message size. SMS messages are normally transferred from an originating Mobile Station (MS) to a terminating MS via a Short Message Service Center (SMSC) belonging to or associated with the home network of the originating MS. The originating MS provides the E.164 address of the SMSC to the serving MSC to enable routing of an SMS message to the SMSC. An SMS-GMSC associated with the SMSC then routes a received SMS message to the terminating MS by

[18] 3GPP TS 26.231: "Cellular Text Telephone Modem; Minimum Performance Requirements".

interrogating the HLR for the terminating MS to determine the address of its serving MSC or SGSN. This set of procedures (defined in 3GPP TS 23.040) can introduce delay – e.g. due to congestion in the SMSC and temporary unavailability of the terminating MS.

SOLUTION A

Routing SMS messages through the SMSC of an originating MS would be one possible solution and would enable the service for both legacy and new MS. However, the home SMSC would need to support SMS message routing to the national SMS relay center which most likely rules out support for international roamers. More serious would be the additional delay in SMS message transfer which could be particularly significant if a conversation will ensue between a PSAP operator and user.

SOLUTION B

An alternative solution to reduce delay would be to equip a national SMS relay center with its own SMSC. This would require an originating MS to recognize any SMS message that is intended for emergency use (e.g. by inclusion of a "911" destination address for the SMS message) and to substitute the E.164 address of a national SMS relay center for the normal E.164 address of the home SMSC when the message is passed to the serving MSC or SGSN. This national E.164 address would need to be configured in the MS. These additional MS functions imply the need for new types of MS and also restrict the capability most likely to North American as opposed to international subscribers.

As outlined above, solution (A) is applicable to legacy MS but can add delay due to routing through the home PLMN. Solution (B) requires new MS but can reduce delay by cutting out transfer through the home PLMN and home SMSC. A viable interim solution needs to support existing MSs and hence propose solution (A) here. It is the one illustrated in Figure 8 and would operate as follows. First a user would compose a text message related to an emergency situation and send this to suitable new national emergency short code address. While such an address could simply be "911", it might be better to define a different standard 5 digit short code (e.g. "91163" representing the key sequence "911ME") for consistency with other short codes and to avoid misleading users into believing this provides a direct link to a local PSAP). The serving MSC would route the SMS message using the 3GPP Mobile Application Part (MAP) protocol (defined in 3GPP TS 29.002[19]) to the home SMSC indicated by the MS (stage 1 in Figure 8). The SMS message would carry both the text message entered by the user and the national emergency short code (e.g. "91163"). The MAP message transporting this SMS message would carry the home SMSC E.164 address and the telephone number (MSISDN) of the MS. The home SMSC would recognize the national emergency short code address and forward the SMS message to the National SMS Relay Center (stage 2 in Figure 8). While MAP could be used for this, it would be better to employ an SMS transfer protocol that can use TCP/IP for transport such as Short Message Peer to Peer (SMPP) or External Machine Interface Universal Computer Protocol (EMI-UCP). The SMS message relayed in this case would contain just the text message entered by the user and the SMPP or EMI-UCP protocol would provide the MSISDN of the originating MS. The home SMSC address would already be known to the National SMS Relay Center from the SMPP binding or EMI-UCP session previously established with the SMSC to initiate SMS transfer. The MSISDN of the originating user and the home SMSC address would need to be retained by the National SMS Relay Center in order to correctly route any SMS replies back to the user – the reply being routed first to the home SMSC which can employ normal 3GPP terminating SMS procedures to route back to the MS

[19] 3GPP TS 29.002: “Mobile Application Part (MAP) specification”.

The above procedures avoid impacts to both the MS and the existing GSM and UMTS infrastructure although require some administrative update of SMSCs to recognize the national emergency short code and correctly route to a National SMS Relay Center. Alternatively, if an operator relies on an SMS aggregator to interface their SMSC to other networks, the SMSC can forward the SMS message received from the MS (in stage 1 in Figure 8) to an aggregator for onward transfer to the National SMS Relay Center. In this case, administrative impacts to the SMSC can be avoided.

At the National SMS relay center, incoming SMS messages could be screened by human operators who could either directly act as a PSAP or originate a voice call to a PSAP and relay (by voice) the text provided in an incoming SMS message. Very likely, two-way communication would need to ensue between the PSAP operator and originating user so the National SMS relay center operator would need to return SMS messages to the user. To ensure that all SMS messages associated with a particular MS are seen by the same operator, the National SMS relay center would need to employ filtering based on the MSISDN of the originating MS.

During emergency calling situations SMS Relay providers encounter difficulties routing 9-1-1 calls to the appropriate PSAP. When a SMS Relay user dials SMS relay service for an emergency, the call is delivered to the SMS Relay and the SMS Relay user indicates that they have an emergency. The SMS Relay interpreter obtains the user's location from either their pre-registered location or from the user themselves. However, if the SMS Relay interpreter dials 911 for emergency services, that call would be connected to the PSAP that services the SMS Relay provider's location and not the PSAP that services the user's current location. Additionally, the information displayed at the PSAP would be that of the SMS Relay provider, not the SMS user.

In order for the SMS Relay provider to contact emergency services in the location of the SMS Relay user, the SMS Relay provider has to determine alternative telephone numbers for the PSAP which serves the SMS Relay user's current location. These alternative telephone numbers are either PSAP administrative telephone numbers or other non-911 emergency telephone numbers. The SMS Relay provider could determine these alternative telephone numbers either from their own internal databases or from other national call routing services. Once the alternative telephone number for the PSAP has been determined, the SMS Relay interpreter can call the PSAP and indicate that they have an emergency call on behalf of an individual with disabilities. The SMS Relay user can then communicate with the PSAP dispatcher via the SMS Relay interpreter, in order to receive the appropriate emergency services.

As a possible workaround, if the location of the MS user could not be subsequently determined by SMS communication with the user, the user might be instructed (via SMS) to originate an E9-1-1 voice call. If the MS was suitably pre-recorded with an appropriate message, it might play out a special announcement to the PSAP operator who might then separately contact the National SMS relay Center and provide the accurate location of the MS user as obtained using E9-1-1 phase 2 capabilities.

An alternative to employing human operators would be to convert SMS text message content directly into speech for messages originated by an MS user and perform the reverse for voice communication from a PSAP operator. This would require some special indication in the call leg to the PSAP (e.g. a short announcement at the start of the call) and would require the PSAP operator to communicate in short speech segments.

The capability so far described can be employed for all users. To restrict the service to hearing and speech impaired users only, prospective users could be required to register their MSISDN address with the National SMS Relay Center. This would allow incoming SMS messages to be filtered. Those from unregistered users would be discarded although a default SMS response might be returned to the user advising the user to place a 9-1-1 voice call. However, messages from registered users would be forwarded to the PSAP either at the National SMS Relay Center or via a Voice call to a remote PSAP as shown in Figure 8.

BENEFITS

Solution A will enable hearing and speech impaired users to use normal SMS for emergency access.

Existing legacy phones can be supported and existing network infrastructure will require only minor administrative update at an SMSC.

LIMITATIONS

The voice call from the SMS Relay Service to the PSAP is not a 9-1-1 call to the PSAP. Rather, these calls are placed to administrative or other auxiliary phone numbers associated with the PSAP and there can be delays of several minutes before the PSAP answers these calls

The caller must have SMS active and know the SMS short code for the National SMS Relay Center. The service will most likely be restricted to North American subscribers due to the need for a home SMSC to recognize a national emergency short code and establish a session or binding with the National SMS Relay Center for transferring SMS messages.

There may be delays in communicating with the final PSAP operator – e.g. due to delays in routing to and from the home SMSC and delays internal to the SMSC. There may be additional delays if there are insufficient human operators or text-voice translation facilities at the National SMS Relay Center.

It will not be possible to obtain an accurate location for the calling user by automatic means. If the caller loses consciousness, is forced to abandon the call, or is unable to communicate, the relay operator does not know that an emergency is occurring (and may not know the caller's location).

The SMS Relay Service needs a suitable mechanism for determining the appropriate PSAP for the caller and routing a call to it.

The SMS is not recognized as emergency related by the handset or network, thus does not have priority treatment and the device does not enter emergency mode.

The service may be subject to misuse – both accidental and deliberate – unless users are required to register with the National SMS Relay Center. For example, it could be subject to frivolous messages (spam) as well as a denial of service attack. In addition, if there is a high uptake for valid usage, facilities at a National SMS Relay Center may become overloaded and unable to provide adequate emergency service.

The service will not be possible in an efficient form without the creation and probably some minimal staffing of a National SMS Relay Center.

The service may later become redundant when equivalent and better multimedia services become available as part of NG9-1-1 deployment.

2.9 VIDEO RELAY SERVICE

DESCRIPTION

With the development of high-quality video equipment, the availability of high speed Internet, and video relay services authorized by the FCC, Video Relay Services (VRS) for the deaf have undergone rapid growth. Using such video equipment in the present day, the deaf, hard-of-hearing and speech-impaired can communicate between themselves and with hearing individuals using sign language. Telecommunication equipment can be used to talk to others via a sign language interpreter, who uses a conventional telephone at the same time to communicate with the deaf person's party. Video equipment is also used to do on-site sign language translation via Video Remote Interpreting (VRI). The development of 3G mobile phone technology with video calling capabilities have given deaf and speech-impaired users a greater ability to communicate with the same ease as others.

With video interpreting, sign language interpreters work remotely with live video and audio feeds, so that the interpreter can see the deaf or mute party, and converse with the hearing party, and vice versa. Much like telephone interpreting, video interpreting can be used for situations in which no on-site interpreters are available. However, video interpreting cannot be used for situations in which all parties are speaking via telephone alone. VRI and VRS interpretation requires all parties to have the necessary equipment. Some advanced equipment enables interpreters to control the video camera remotely, in order to zoom in and out or to point the camera toward the party that is signing.

In the U.S., the FCC regulates the standards that VRS companies and their employees must follow in handling calls. These regulations ensure that VRS calls are handled appropriately and ethically. The FCC-issued rulings include:

- The time it takes an interpreter to answer an incoming VRS call. As of July 1, 2006, VRS providers must answer 80% of calls within two and a half minutes. Starting on January 1, 2007 VRS providers must answer 80% of calls within two minutes;
- as of January 1, 2006, all VRS providers are required to provide service 24 hours a day, seven days a week;
- reimbursement of VRS Video Mail: if a Hearing person calls a sign language user, but there is no answer, the VI signs a message and delivers it to the sign language user's e-mail, similar to an answering machine.
- VRS providers are not permitted to “call back” when a customer hangs up before a VRS call is placed.

Typical calling procedure for VRS includes the following:

- An individual who communicates by American Sign Language uses video equipment to connect via broadband Internet to a Video Relay Service;
- the caller is routed to a sign language interpreter, known as a Video Interpreter (VI). The VI is in front of a camera or videophone;
- the video user gives the VI a voice number to dial, as well as any special dialing instructions;
- the VI places the call and interprets as a neutral, non-participating third party. Anything that the audio user says is signed to the video user, and anything signed by the video user is spoken to the audio user;
- once the call is over, the caller can make another call or hang up with the interpreter;
- the company that provides the interpreter services will then submit billings to the FCC.

VRS can be used by anyone to contact a DHHSI person. To initiate a call, a hearing person calls a VRS and connects to a video interpreter who then contacts the video user. Some VRS services also offer:

- Voice Carry Over (VCO): The video user may use his/her own voice instead of the interpreter speaking;
- Hearing Carry Over (HCO): the video user may listen for him/herself instead of relying on the interpreter;
- Language Preference: The video user requests that the interpreter use American Sign Language;
- the ability to connect to a sign language interpreter who can interpret into another language, such as Spanish.

Some relay services allow callers to register and obtain a standard Directory Number (DN), for example, a 10-digit North American Numbering Plan (NANP) number in the U.S. When available, and depending on the service, the user's DN may be provided to the relay operator and may be provided to the PSAP, allowing for call backs.

During emergency calling situations VRS providers encounter difficulties routing 9-1-1 calls to the appropriate PSAP. When a VRS user dials video relay service for an emergency, the call is delivered to the VRS and the VRS user indicates that they have an emergency. The VRS interpreter obtains the user's location from either their pre-registered location or from the user themselves. However, if the VRS interpreter dials 911 for emergency services, that call would be connected to the PSAP that services the VRS provider's location and not the PSAP that services the user's current location. Additionally, the information displayed at the PSAP would be that of the VRS provider, not the VRS user.

In order for the VRS provider to contact emergency services in the location of the VRS user, the VRS provider has to determine alternative telephone numbers for the PSAP which serves the VRS user's current location. These alternative telephone numbers are either PSAP administrative telephone numbers or other non-911 emergency telephone numbers. The VRS provider could determine these alternative telephone numbers either from their own internal databases or from other national call routing services. Once the alternative telephone number for the PSAP has been determined, the VRS interpreter can call the PSAP and indicate that they have an emergency call on behalf of an individual with disabilities. The VRS user can then communicate with the PSAP dispatcher via the VRS interpreter, in order to receive the appropriate emergency services.

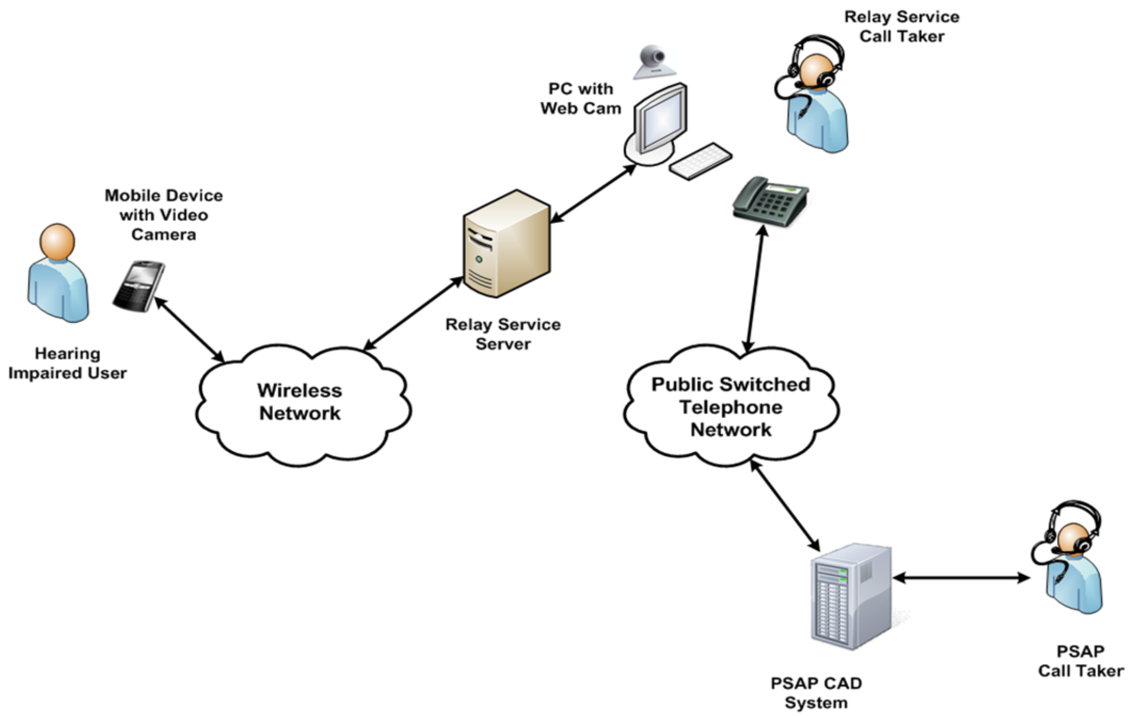

Figure 9: Video Relay Service

BENEFITS

This service enables hearing and speech impaired users to use and existing technology to interact. This service requires minimal changes to standards and can be readily deployed and used.

The hearing and speech impaired users are already familiar with using this service to communicate.

LIMITATIONS

The voice call from the Video Relay Service to the PSAP is not an 9-1-1 call to the PSAP. Rather, these calls are placed to administrative or other auxiliary phone numbers associated with the PSAP and there can be delays of several minutes before the PSAP answers these calls.

This service requires a phone capable of video telephony (e.g., front facing camera, appropriate video applications, handset positioning stand) that is compatible with the Video Relay Service video application. Although, many of the recent smartphones have this capability, it is not universally available in all devices. It also requires a data packet service with a minimum bit rate to work properly; as such, it is not suitable for legacy (2G) access technologies.

The caller must be able to contact the Video Relay Service, or have a client pre-configured with this information. If the Video Relay Service is not nationwide, then determining this becomes significantly more difficult.

When prior registration and call-time authentication are used by the VRS, the broad usefulness of the relay service is limited by requiring advance action by all users who need the service. Without prior registration, protection against attacks is more difficult (but to the extent that authentication and registration are trivial and easily minted, the protection afforded is limited). Call-time authentication often means that credentials need to be stored on the device (since entering them during an emergency may be impracticable). This creates additional challenges in cases where a device is replaced or borrowed.

It will not be possible to obtain an accurate location for the calling user by automatic means. If the caller loses consciousness, is forced to abandon the call, or is unable to communicate, the relay operator does not know that an emergency is occurring (and may not know the caller's location).

The Video Relay Service needs a suitable mechanism for determining the appropriate PSAP for the caller and routing a call to it.

The video session is not recognized as an emergency session by the handset or network, thus does not have priority treatment and the device does not enter emergency mode.

For those services that do not assign a standard DN, callback by the PSAP is difficult and may not be possible, since no calling number information is sent. Even though the Video Relay Service does have access to the source IP address, this is of little practical use in determining the caller.

The interfaces and interactions between the individual with disabilities and the Video Relay Service are proprietary in nature and are dependent on the implementation of the Video Relay Service.

2.10 IP BASED RELAY SERVICE

DESCRIPTION

IP based relay service allows various IP based texting message services to interoperate. Various IP-based text messaging service protocols can be used between the caller and the IP Relay Service. These may include web pages or web services (using HTTP or HTTPS), open standards instant messaging (XMPP (Jabber), SIP/SIMPLE), commercial instant messaging (Google Talk/Google Chat, iChat, AIM, Yahoo, MSN), proprietary protocols (Yahoo IM, AIM, MSM), etc. The relay service might be limited to one mode or protocol, or support multiple protocols, for example, one or more forms of IM plus a web based service.

Some relay services allow callers to register and obtain a standard Directory Number (DN), for example, a 10-digit North American Numbering Plan (NANP) number in the U.S. When available, and depending on the service, the user's DN may be provided to the relay operator and may be provided to the PSAP, allowing for call backs. Some services allow the user to register a location, which is then provided to the relay service or the PSAP. Such services generally permit users to update their registered location as needed.

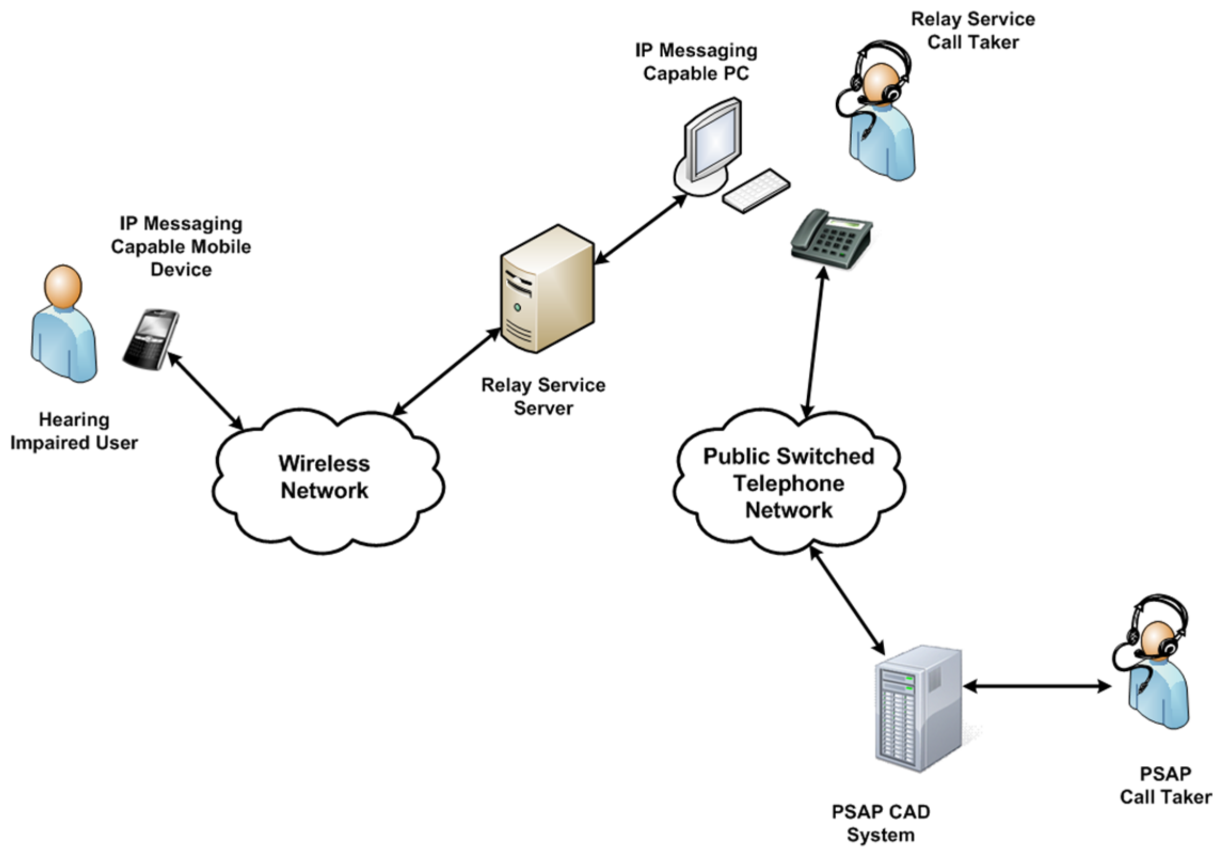

Figure 10: IP Based Relay Service

During emergency calling situations IP Relay providers encounter difficulties routing 9-1-1 calls to the appropriate PSAP. When an IP Relay user dials an IP relay service for an emergency, the call is delivered to the IP Relay Service and the IP Relay Service user indicates that they have an emergency. The IP Relay Service interpreter obtains the user's location from either their pre-registered location or from the user themselves. However, if the IP Relay Service interpreter dials 911 for emergency services, that call would be connected to the PSAP that services the IP Relay Service provider's location and not the PSAP that services the user's current location. Additionally, the information displayed at the PSAP would be that of the IP Relay Service provider, not the IP Relay Service user.

In order for the IP Relay Service provider to contact emergency services in the location of the IP Relay Service user, the IP Relay Service provider has to determine alternative telephone numbers for the PSAP which serves the IP Relay Service user's current location. These alternative telephone numbers are either PSAP administrative telephone numbers or other non-911 emergency telephone numbers. The IP Relay Service provider could determine these alternative telephone numbers either from their own internal databases or from other national call routing services. Once the alternative telephone number for the PSAP has been determined, the IP Relay Service interpreter can call the PSAP and indicate that they have an emergency call on behalf of an individual with disabilities. The IP Relay Service user can then communicate with the PSAP dispatcher via the IP Relay Service interpreter, in order to receive the appropriate emergency services.

BENEFITS

Fundamentally, all that is required on the handset is IP (and TCP for many protocols) and a text messaging client which supports one of the protocols used by the relay service. All that is required in the network is IP. No additional requirements are placed on the PSAP. Hence, this approach in theory can be provided to the broadest possible set of users.

Multiple IM protocols can be supported within one client. (For example, one popular open-source[20] client available for various platforms today supports the following IM protocols: AIM, MobileMe/.Mac, ICQ, XMPP/Jabber, Google Talk, Facebook Chat, LiveJournal, .NET Messenger Service/MSN/Windows Live, Yahoo! Messenger, MySpaceIM, Gadu-Gadu, Novell GroupWise, Lotus Sametime, Tencent QQ, MeBeam with a plugin, Tlen with a plugin, Xfire with the XBlaze plugin, Skype with a plugin, IRC, Twitter, and NateOn with a plugin; another[21] supports AIM, Bonjour, Gadu-Gadu, Google Talk, Groupwise, ICQ, IRC, MSN, MXit, MySpaceIM, QQ, SILC, SIP/SIMPLE, Sametime, XMPP, Yahoo!, and Zephyr). Thus, it is not conceptually difficult to support multiple IM protocols within the IP Relay Service or the client, although of course there are fewer resource limitations and easier upgrades on the server side.

A service may be open to anonymous users (no authentication at call time), or may require advance registration with call-time authentication. The registration and authentication may be essentially trivial (such as requiring only an email account), or may be tied to some external account.

LIMITATIONS

The voice call from the IP Relay Service to the PSAP is not an 9-1-1 call to the PSAP. Rather, these calls are placed to administrative or other auxiliary phone numbers associated with the PSAP and there can be delays of several minutes before the PSAP answers these calls.

The handset must support at least one protocol in common with the IP Relay Service and have packet data services active. With some services, neither location nor calling number information is sent (although some protocols have provisions for transmitting location information, either directly from the originating end point to the relay's end point, or from the originating end point to a location or presence server which in turn may make it available to the relay's end point). In services without automatic location information, the relay operator must obtain a location by asking the caller, which delays routing the call to the appropriate PSAP. Even for those services that do provide location, because the location may be out of date, the relay operator will usually ask the caller to confirm it. Generally, the relay operator verifies that the caller requires emergency services and asks for a location prior to determining the PSAP and then placing the call. (This is similar to the operation of in-vehicle telematics services such as OnStar, except that OnStar has the location automatically.)

The caller must be able to contact the IP Relay Service, or have a client pre-configured with this information. If the IP Relay Service is not nationwide, then determining this becomes significantly more difficult.

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[20] See Adium: http://adium.im/

[21] See Pidgin: http://www.pidgin.im/

It will not be possible to obtain an accurate location for the calling user by automatic means. If the caller loses consciousness, is forced to abandon the call, or is unable to communicate, the relay operator does not know that an emergency is occurring (and may not know the caller's location).

The text communication session is not recognized as an emergency session by the handset or network, thus does not have priority treatment and the device does not enter emergency mode.

For those services that do not assign a standard DN, callback by the PSAP is difficult and may not be possible, since no calling number information is sent. Even though the IP Relay Service does have access to the source IP address, this is of little practical use in determining the caller.

The caller must know the domain name of the IP Relay Service, or have a client pre-configured with this information. If the IP Relay Service is not nationwide, then determining this becomes significantly more difficult.

When prior registration and call-time authentication are used, the broad usefulness of the relay service is limited by requiring advance action by all users who need the service. Without prior registration, protection against attacks is more difficult (but to the extent that authentication and registration are trivial and easily minted, the protection afforded is limited). Call-time authentication often means that credentials need to be stored on the device (since entering them during an emergency may be impracticable). This creates additional challenges in cases where a mobile device is replaced or borrowed.

The IP Relay Service needs a suitable mechanism for determining the appropriate PSAP for the caller and routing a call to it. Such solutions do exist and are in use (e.g., OnStar), but the need for this is a limitation.

3. ANALSYS OF POTENTIAL TECHNIQUES

This section of the white paper provides the analysis of the potential techniques including a color coded side-by-side comparison. Section 3.1 provides the definition of the analysis criteria and the associated color coding that will be used in the side-by-side comparison. Section 3.2 provides the color coded side-by-side comparison table including any appropriate notes which are provided immediately following the table.

3.1 DEFINITION OF ANALYSIS CRITERIA

The following table defines the analysis criteria and associated color coding that will be utilized for the evaluation of the various potential techniques:

Table 1: Definition of Analysis Criteria

Analysis Criteria	Definition	Definition of Analysis Color Coding		
		Red	**Yellow**	**Green**
Real-time communication	Is the multimedia communications between the end user and emergency services conducted in real-time or does queuing, store-and-forward, or other such techniques occur?	Communications with extensive delays due to queuing, store-and-forward, or other delays occur	Communications with appreciable delays	Communications with no noticeable delay
End user location determination	Does the potential technique support end user location determination or does the end user have to provide their location during the multimedia communications with emergency services?	End user has to provide their location	N/A	Potential technique can determine end user location
Reliability	How is reliable is the potential technique?	Little to no reliability	High reliability but could fail	Supports telco grade of five 9's reliability (99.999%)
Security	Are the communications between end user and emergency services secure and protected against false messages, altered messages, man-in-the-middle attacks, etc?	No security capabilities	Limited security capabilities	Extensive security capabilities

Analysis Criteria	Definition	Definition of Analysis Color Coding		
		Red	**Yellow**	**Green**
Maintaining association between end user and PSAP call taker when end user is mobile	Does the technique maintain the association of multimedia emergency services between the end user and the PSAP call taker when the end user is mobile?	Communications may not stay with the same call taker.	N/A	Communications stays with the same call taker.
Pre-registration with emergency services required?	Does the user need to be known in advance to emergency services per a pre-registration function?	No service is enabled to the end user without a pre-registration	N/A	No pre-registration is required. No action required by wireless operator or emergency services
Impact to PSAP systems	What is the impact to the existing PSAP systems and the associated call takers?	New capabilities required in PSAP systems.	Capabilities existing in current PSAP systems but training of PSAP call takers may be required	No impact to PSAP systems
Impact to wireless operators networks	What is the impact to the existing wireless operator networks?	New network components and/or new interfaces required	Supported by existing network components and interfaces. Network engineering may be needed for additional traffic load.	No impact to wireless operator networks
Impact to end user	Are new handsets and/or applications required?	New handsets required	New application on smart phone required	Existing handset supports technique
Migration impact to end user for transition to long term	What are the migration impacts from the short term technique to the long term solution?	End user will have to use a different technique for the long term multimedia emergency communications	End user could use the same technique but a new version of the application may be require and there may be changes to the user interface	Long term solution will be the same to the end user

3.2 SIDE-BY-SIDE TECHNIQUE COMPARISON

The following table provides a color coded side-by-side summary comparison of the potential techniques. The definition of the Analysis Criteria column and the explanation of the color coding are provided in Table 1: Definition of Analysis Criteria in Section 3.1. The description of the potential techniques is provided in section 2.

Any notes referenced within the color coded side-by-side comparison table are provided immediately following the comparison table.

Table 2: Side-by-Side Technique Comparison

Analysis Criteria	Instant Messaging	Video ASL	RTT End-to-End	RTT with TTY	SMS to 9-1-1	Voice Emergency Call then SMS	TTY Emulation	National SMS Relay Center	Video Relay Service	IP Based Relay Services
Real-time communication	Note 1									
End user location determination										
Reliability										
Security										
Maintaining association between end user and PSAP call taker when end user is mobile								Note 2	Note 2	Note 2
Pre-registration with emergency services required?										
Impact to PSAP systems	Note 3	Note 3	Note 3		Note 3	Note 3				
Impact to wireless operators networks			Note 4	Note 4						
Impact to end user	Note 5	Note 5	Note 5	Note 5			Note 6			
Migration impact to end user for transition to long term					Note 7	Note 7		Note 7		

Note 1: Some IM implementation may use store and forward capabilities.

Note 2: Maintenance of association between end user and PSAP call taker would be provided by the relay service.

Note 3: Updates to existing PSAP systems required.

Note 4: IMS is required in the wireless operator network

Note 5: Subscriber would need to download application if current mobile device supports downloaded application. If not, subscriber would need to get a new mobile device.

Note 6: Subscriber would need to get a new mobile device.

Note 7: Long term solution will support text messaging but the text messaging capability will be supported by other techniques instead of SMS.

4. CONCLUSIONS

Based upon the analysis contained within this white paper, the following conclusions can be drawn regarding an interim short-term solution:

1. All of these potential techniques have issues and limitations which impacts the use of the technique as an interim short term solution. Subscribers will need to be educated that any interim solution will have limitations and restrictions.

2. Relay based services such as Video Relay Service and IP Based Relay Service are potential techniques for an interim solution. These techniques have minimal impact to existing mobile devices, to wireless network infrastructure, and to emergency services networks.

3. SMS based techniques such as National SMS Relay Center and the Voice Emergency Call then SMS are potential techniques for an interim solution, if an SMS based solution is required. These SMS based techniques have the same inherent issues of SMS as described in the 4G America's white paper on texting to 9-1-1[22] which was published in October 2010. These techniques have little or no impact to the wireless networks and limited impact to the emergency service networks. However, not all currently deployed mobile devices will support the Voice Emergency Call then SMS technique. The Voice Emergency Call then SMS technique is currently under trial in Canada.

4. SMS to 9-1-1 continues to have serious issues and limitations as described in the 4G America's white paper on texting to 9-1-1[22]. Implementation of SMS to 9-1-1 would have significant impacts to wireless network infrastructure and to the emergency services networks and, therefore, is not considered to be a suitable interim solution.

5. Interim solutions based upon real-time text (RTT) are not feasible as interim solutions since the 3GPP standards for the support of RTT in wireless networks requires the IMS subsystem. The IMS subsystem is not widely deployed, is not likely to be deployed on 3G systems, will not be deployed on 2G systems, and is not supported by the mobile devices currently being used by the subscribers.

[22] 4G Americas, *Texting to 9-1-1: Examining the Design and Limitations of SMS*, October 2010.

6. Instant Messaging (IM) is not considered to be a viable technique for an interim solution. Generally, the IM services available to subscribers today are the services offered by the major IM service providers such as AOL, Yahoo, Google, and Microsoft. None of these services currently support emergency messaging so additional development would be required by these third party IM service providers and by the PSAP systems. Additionally, since these systems are proprietary, the PSAP systems may have to interface to each of these IM services.

7. Video ASL is not considered to be a viable technique for an interim solution. The ability of the existing wireless network to support the required video resolution is marginal. The PSAP systems would need to be updated to support incoming video calls. Additionally, proficiency in American Sign Language is not a common skill for PSAP call takers.

8. TTY Emulation is not a viable technique for the interim solution. For TTY Emulation to work effectively modifications to the mobile device operating systems are required which implies new mobile device development and new mobile device acquisition by the subscribers. Initial prototype systems have demonstrated the potential of the concept but have not yet been able to meet the FCC requirements for error rate.

None of the short-term techniques for multimedia emergency services can be supported without a significant development effort. The implementation of any short-term interim techniques for multimedia emergency services will require resources and time to develop and deploy. Also, the issue of funding for the development and deployment of any short-term technique also needs to be addressed.

APPENDIX A. ACRONYMS AND DEFINITIONS

A.1 ACRONYMS

3GPP	3rd Generation Partnership Project
A-GPS	Assisted GPS
ADA	American Disability Act
AIM	AOL Instant Messaging
APEX	Application Exchange
ASL	American Sign Language
CISC	Canadian Radio-television Telecommunications Interconnection Steering Committee
CRTC	Canadian Radio-television and Telecommunications Commission
CS	Circuit Switched
CTM	Cellular Tone Modulation
DHHSI	Deaf, Hard of Hearing, or Speech Impaired
DN	Directory Number
E9-1-1	Enhanced 9-1-1
DNS	Domain Name Service
EMI	External Machine Interface
ESWG	Emergency Services Working Group
FCC	Federal Communications Commission
FSK	Frequency Shift Keying
GPS	Global Positioning System
GSM	Global System for Mobile communications
GTT	Global Text Telephony
GUI	Graphical User Interface
HCO	Hearing Carry Over
HLR	Home Location Register
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IETF	Internet Engineering Task Force
IM	Instant Messaging
IMPS	Instant Messaging and Presence Service
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol

ITU	International Telecommunication Union
ITU-T	ITU Telecommunication standardization sector
LTE	Long Term Evolution
MMES	Multimedia Emergency Services
MS	Mobile Station
MSC	Mobile Switching Center
MSISDN	Mobile Station Integrated Services Digital Network
NANP	North American Numbering Plan
NG9-1-1	Next Generation 9-1-1
NENA	National Emergency Number Association
OMA	Open Mobile Alliance
PLMN	Public Land Mobile Network
PRIM	Presence and Instant Messaging Protocol
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
RERC	Rehabilitation Engineering Research Center
RFC	Request for Comments
RTT	Real Time Text
SDP	Session Description Protocol
SIM	Subscriber Identity Module
SIMPLE	SIP for Instant Messaging and Presence Leveraging Extensions
SIP	Session Initiation Protocol
SMPP	Short Message Peer-to-Peer
SMS	Short Message Service
SMSC	Short Message Service Center
T9-1-1	Text messaging to 9-1-1
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TDD	Telecommunication Device for Deaf
TTY	Teletype
UCP	Universal Computer Protocol
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
VCO	Voice Carry Over
VI	VRS Interpreter

VRI	Video Remote Interpreting
VRS	Video Relay Service
XML	Extensible Markup Language
XMPP	Extensible Messaging and Presence Protocol

A.2 DEFINITIONS

PSAP	A PSAP is a set of call takers authorized by a governing body and operating under common management which receives 9-1-1 calls and asynchronous event notifications for a defined geographic area and processes those calls and events according to a specified operational policy.
SMS	The Short Message Service (SMS) provides a means of sending messages of limited size to and from mobiles. The provision of SMS makes use of a Service Center, which acts as a store and forward center for short messages.

APPENDIX B. DESCRIPTION OF INSTANT MESSAGING ARCHITECTURE & PROTOCOLS

B.1 ARCHITECTURE & PROTOCOLS

The general principles of architecture behind IM implementations may be abstracted to a generic Presence service architecture of which IM may be thought of as being a specific instance. While IM applications have been around for a few decades and implementations vary dramatically, more recently, the Open Mobile Alliance (OMA) standards body has formalized an Instant Messaging and Presence Services (IMPS) architecture. The stated goal of IMPS is "to define and promote a set of universal specifications for mobile instant messaging and presence services. The specifications are to be used for exchanging messages and presence information between mobile devices, mobile services and Internet-based instant messaging services, all fully interoperable and leveraging existing web technologies". The IMPS system is a client-server-based system, where the server is the IMPS server and clients can be either mobile terminals, or other services/applications, or fixed PC-clients[23]. The figure below depicts the OMA defined architecture for IMPS:

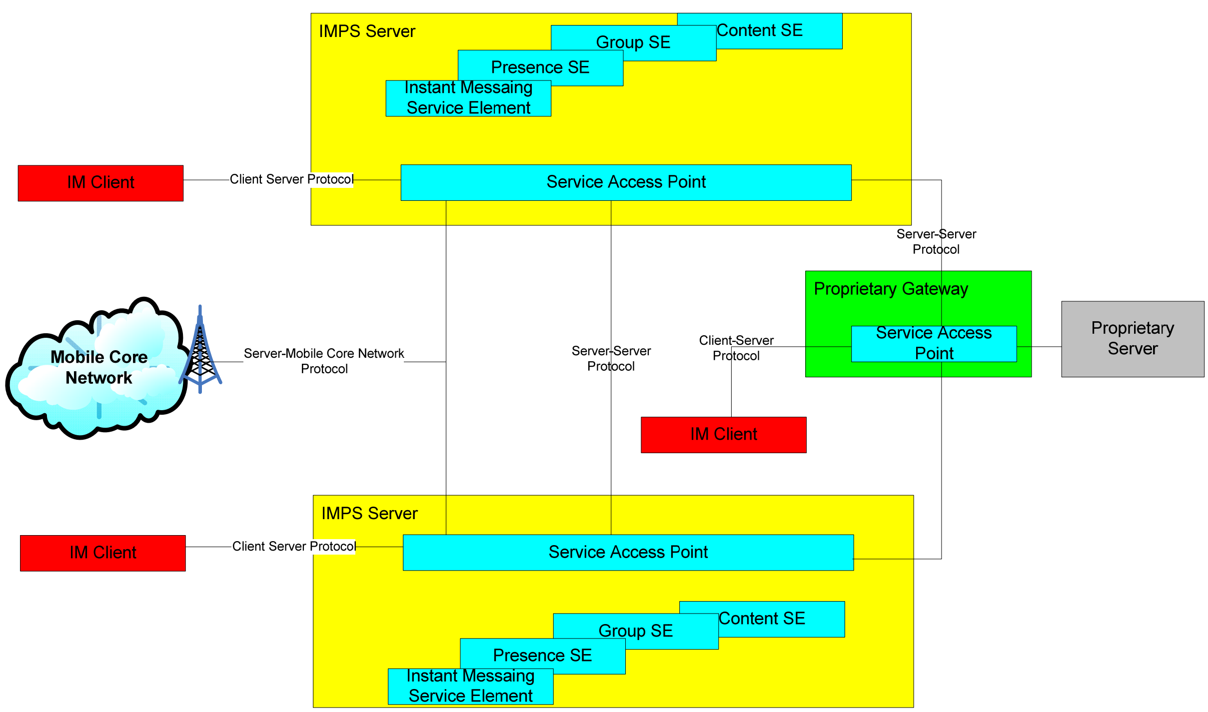

Figure 11: OMA IMPS Architecture

The key elements of the OMA IMPS architecture pertaining to IM are as follows:

- IMPS Server – The central point of an IMPS system which houses the Service Elements and the Service Access Point functions;

[23] IMPS Architecture – Approved version 1.3, 23 Jan 2007 – Open Mobile Alliance

- IMPS Service Element – The Presence Service Elements provides functionality for Presence Information Management – this includes ability for users or the system to update, retrieve, set and store presence and location information. Users can subscribe to the Presence information of other users as specified in a contact list. Presence information can be obtained from multiple sources including the mobile core network. IM is a specific instance of a Service Element offered by an IMPS server. Other Service Elements include Group, Content and General Presence services;

- Service Access Point (SAP) – The interface between an IMPS server and its environs – i.e. to the IMPS Client, other IMPS servers, to the mobile core network etc. The functions of this element include – authentication and authorization, service discovery and agreement, user profile management, and service relay;

- IMPS Client – Refers to the end-device. For IM, this could be a laptop, PC or mobile device.

The key interfaces/protocols as pertaining to IM can be outlined as follows[24]:

- Client-Server Protocol (CSP) - The IMPS client communicates with the IMPS Service Element (for instance, IM) on the IMPS Server using a Client-Server Protocol (CSP). The CSP is bearer agnostic – i.e. it can be built on multiple transport types depending on the specific implementation;

- Server-Server Protocol (SSP) - IMPS servers may communication with one another using Server-Server Protocol (SSP) either within one service provider's domain or across multiple service-providers' domains.

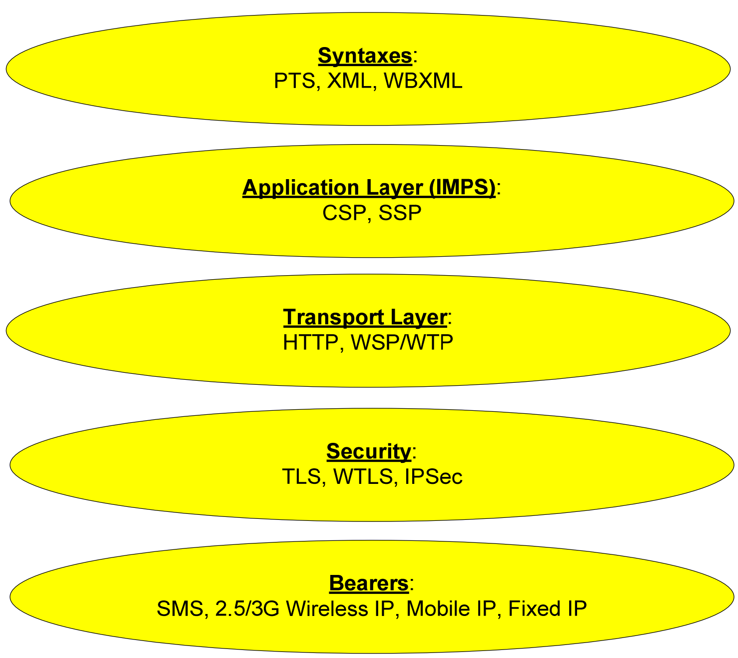

Figure 12: OMA IMPS – Interfaces and Protocols

[24] IMPS Architecture, Approved Version 1.3 – 23 Jan 2007, Open Mobile Alliance, OMA-AD-IMPS-v1-20070123-A; Available at http://openmobilealliance.org

IM applications come in two flavors – Enterprise IM and Consumer IM. In a typical Enterprise IM application, the IM server is hosted by the Enterprise with the user community being limited to other Enterprise members – although some Enterprises may permit users to communicate outside the ecosystem. Enterprise IMs require the deployment of dedicated hardware server to run the server application. It allows Enterprises to manage communications more closely and in alignment with business interests – for instance, encryption and archiving of conversations are considered important features for corporate users. Companies such as Oracle, IBM and Microsoft have Enterprise IM applications that are integrated as part of an Office Work-flow system. On the other hand, Consumer IM applications do not require dedicated hardware. Users are able to access an Internet-accessible IM Server and are able to communicate with other users who also use that IM application. Examples of such application include Yahoo! Messenger and Google Talk etc. In either case, it may be possible to use the IM application from either a fixed or mobile device.

Mobile Operators may also deploy IM servers within their IP Multi-media Service (IMS) domain. Such a deployment would permit mobile users to use an Operator provided IM application to communicate with other mobile or fixed line user depending on the implementation. Although such deployments are possible, they are not widespread at the time of this writing and hence are not considered further in this paper. Most mobile operators permit their users to access over-the-top IM applications – where an IM client installed on the mobile phone communicates directly with a globally accessible IM server over a data connection built using an operator's packet core.

B.2 LIMITATIONS

There is a plethora of IM applications available that vary widely in their features, capabilities, and implementation. Some applications (e.g. Google Talk) only allow for exchange of textual messages, while others permit exchange of voice, video and other multi-media formats (e.g. Yahoo! Messenger) which may require additional hardware to be installed on the end-user's device –for instance, a web-cam to support video or a microphone to support voice. Thus, IM application capabilities are not standardized across all applications. This presents challenges to the PSAP who may have to support all available IM types in order for all subscribers to be able to reach them.

Interoperability between IM applications remains a concern though popular multi-protocol client software has been very effective.. There have been efforts to unify and standardize the protocols – most notably, the IETF has recommended the user of Session Initiation Protocol (SIP) and SIP for Instant Messaging and Presence Leveraging Extensions (SIMPLE). Other efforts include APEX (Application Exchange), PRIM (Presence and Instant Messaging Protocol), the open XML-based XMPP (Extensible Messaging and Presence Protocol), and OMA's (Open Mobile Alliance) IMPS (Instant Messaging and Presence Service) created specifically for mobile devices. These are yet to catch on with most client-server protocol implementations remaining proprietary. There have been some collaboration between the major IM providers that are worthy of note – Yahoo! and Microsoft IM applications do interwork using the SIP/SIMPLE protocol. Google and AOL collaborate to enable Google Talk users to communicate with AOL Instant Messaging (AIM) users. However, no universal standard has taken hold.

IM applications challenge the capabilities of the current circuit-switch centric 9-1-1 call routing and location infrastructure. Traditional voice-based 9-1-1 calls made over circuit-switched wireless networks involve two distinct events a) location based routing – i.e. based on the Cell of Origin the network routes the call to an appropriate PSAP that has jurisdiction over the caller's location and b) automatic location determination – i.e. when the call is answered by the PSAP-call-taker the system automatically provides location information associated with the call using the location determination infrastructure deployed in the operator's network. The characteristic of circuit-switched network which make both these functions possible is the close association between the access provider and the service provider which are one and the same – i.e. the access in this case is the circuit connection and the service is the voice call and they are both provided by one and the same operator.

IM is a packet-switched/ Internet Protocol based service that breaks this close association that exists in the CS-domain. As noted, most IM applications are provided by 3rd parties such as Google, Yahoo, Skype or MSN who do not control the access network and in virtually all cases may even be unaware of the access type used to connect to their service. An IM subscriber may access the service from any point of Internet connectivity – be it wireless broadband network (2.5G or 3G), Cable, DSL or other Wi-Fi hotspots. From the perspective of the IM service, it works in the same manner irrespective of the underlying connection type. The access network for its part may not be aware of the services that the subscriber is accessing.

Another key difference between the circuit-switched and IP services is the user identity. In the case of CS services, it is closely tied to the device. For instance, in the case of CS, a subscriber registers with the network using a mobile ID (typically an IMSI or MSISDN) and when making a call, uses the same identity. However, in the case of IP services such as IM, multiple identities are usually involved – For e.g. a user may sign on to their access (Wireless, DSL or cable) using a particular identity but may use a completely different identity to access their IM application.

The differences between the traditional CS-service and IP-services detailed above poses issues for routing and location determination when it comes to providing the same services for IM. In CS-network, the MSC (the CS equivalent of the voice service provider in the PS-network) recognizes an Emergency Call Origination and routes the call to the PSAP based on the Cell of Origin (COO) obtained from the Radio Access Network (RAN). Simultaneously, it also kicks off the location determination process towards a Positioning Determination Entity (PDE) that is located within the access network and which uses the measurements obtained from the access network and perhaps the device itself to determine the caller's location. However, the same model cannot be transferred over to support IM applications. For instance, the IM Server may not be able to recognize an emergency situation. Furthermore, not knowing the identity or the nature of the access type through which the user is connected to means that IM server may not be able to kickoff a location determination process nor route the call to a PSAP that has jurisdiction over the caller's location. There are several architectures defined by NENA (i3), 3GPP (IMS architecture) and IETF (IP Location Architecture) which address the issue of separation of service and access layers and how location acquisition and conveyance can work under these environments. These involve new nodes such as the Location Routing Function (LRF), Location Information Server (LIS), LoST (Location to Service Translation) which provide location determination and routing functions in an IP environment. However, these haven't been widely implemented as yet and may not be done so for quite a while.

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